

risks. This should be made in every case. For those who are not familiar with his classification, I will state he has divided surgical cases into three classes:

First: Elective surgical risks with a good, fair or bad prognosis.

Second: Emergency surgery, classified also as good, fair or bad risks.

Third: Palliative surgery, classified in a like manner.

A wise provision by the ideal hospital would be to require consultation before the contemplated operation in those cases where the patient's life is to be endangered. This provision would not necessarily be enforced in emergency work where the loss of time might be detrimental to the patient's chances of recovery. Such a procedure would not only safeguard the patient, but also the doctor in the eventuality of an unfortunate result.

The mechanical compilation of statistics enables each doctor to know his own results and also the average results of all others, but not the individual results of any save his own. The value of such records must be apparent to all. The worth of any surgical procedure could be determined promptly and in a convincing manner. Each would profit by the experiences of all.

An example: Since an analysis of the work in the Los Angeles General Hospital has been made during the past two years, there has resulted a very marked stimulation of interest in their mortality showings and in the proportion of creditable results on the parts of the various surgeons. It seems only just that some form of recognition be accorded those institutions which require such an analysis of their work.

Compilation of vital statistics including all methods of treatment, show a steady deterioration of results. The better institutions have shown an improvement consistent with the advancement of medical science. This comparison constitutes the clinching argument against unpreparedness and quackery.

Financial institutions where only money is at stake are required to give a true statement of assets, liabilities, and the chance for gain to the prospective investor. Institutions of treating the sick are not surrounded by any such safeguards.

This has been the golden age of opportunity in medicine and we can do no more than pass to our successors a better organization than that we have received.

In conclusion, it is just that we exercise every precaution to safeguard the lives and welfare of the patients who trustingly place themselves in our care. To do this it is imperative that the physician know the results that follow his work.

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TUBERCULOUS CAVITIES—THEIR DIAGNOSIS BY THE ROENTGEN RAY *

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DISCUSSION by Carl H. Parker, M.D., Pasadena; Charles G. Sutherland, M.D., Rochester, Minnesota; H. S. Hunsberger, M.D., San Francisco.

CAVITY formation plays an important part in the progress and prognosis of pulmonary tuberculosis, and its early diagnosis is extremely important.

FORMATION OF CAVITIES

Some believe that the formation of a cavity depends in a good part on secondary infection with the various pus-producing organisms, but the recent exhaustive work of Medlar and Krause explodes this theory and shows that it is due entirely to the polymorphonuclear leukocytes in the reaction to the tubercle bacilli; and the presence of which is no indication of secondary infection. All tuberculous ulcers and cavities are formed in the same way, first, by the implantation of the tubercle bacilli; second, by the softening of a mass of cells with a separation from the surrounding tissues, then a rupture, usually near the center. The cavities may be pinhead in size or occupy a whole lobe or an entire lung. Cavities may have smooth, dry walls, or may be ragged and secreting. As a rule the more chronic a cavity the smoother its walls. A cavity may at one time contain secretion and at another time be empty. These various conditions necessarily produce different physical signs. All cavities of any size usually extend to the wall of a bronchus, which subsequently ulcerates and permits the evacuation of the liquefied contents. A cavity just beneath the visceral layer of pleura may perforate into the pleura cavity, producing an open or valvular pneumothorax.

SILENT CAVITIES

It is generally taught that the classical amorphic signs of cavities are distinctive only of the larger ones, whereas the great majority which are small do not betray their presence by abnormal physical signs. About 50 per cent of all tuberculous cavities, regardless of size, are silent, according to the conclusions of Bendove.

ROENTGEN RAY IN CAVITY DIAGNOSIS

There is perhaps no phase of tuberculosis upon which the roentgen ray has shed more light than on cavitation. The following quotation is taken from the July, 1926 issue of the *American Review of Tuberculosis*, from the Fitzsimmons General Hospital Medical Corps, United States Army, Denver, Colorado: "During the past four years annular shadows have been carefully studied. Cases of annular shadows that were diagnosed by the roentgen ray, but without physical signs, were reported by ward officers and were further studied and checked up, and almost invariably the existence of a cavity could be proven. Three hundred and seventy-five autopsies on tuberculosis subjects were studied. Three hundred and forty-nine had

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cavities demonstrated at autopsy; in all these signs of cavities were seen in the x-ray plates. Our pathologist found a few localized pneumothoraces, but the so-called pleura rings could never be found."

The article above referred to has been a revelation to me; it has helped to clear up several doubtful things, namely, pleural shadows, localized pneumothorax, and, of course, annular shadows in general. There are not enough articles of this kind that deal with so many autopsy checks.

The favorite site of infection with pulmonary tuberculosis is in the upper lobes, hence the prevalence of tuberculous cavities also in these regions. Here, too, fortunately these cavities are more easily demonstrated, owing to their superficial situation and are found quite commonly in early lesions, and of course when found, change the clinical classification from minimal to far advanced, thus changing the prognosis as well.

It is not uncommon, especially at the roots of the lungs, for the blood vessels and indurated and caseous lymph nodes to be so arranged as to simulate cavities in the x-ray examination. Cavities in this region are quite rare, however. A confusion between the cross-section of a bronchus and a cavity is possible only to the inexperienced. Sometimes annular shadows are indicative of a zone of demarcation about an infiltration, which infiltration will eventually result in a definite cavity, and these are sometimes difficult to diagnose at an early stage. But sooner or later the defect will become absorbed, converted into fibrosis, or show a definite wall of cavity formation. Small areas of rarefaction and small cavitation are sometimes very hard to diagnose, particularly when there is beginning fibrosis in an area of caseous tissue, the new connective tissue interweaving so as to closely resemble beginning cavitation and can only be differentiated by definite wall and punched-out appearance. The aspect of tuberculous cavities depends upon their age, location, and the pathological tissue in which they are found. They usually occur as more or less well-defined ring-shaped bands of increased density. Within the ring of increased density there is a field of markedly diminished density in most cases.

CLASSIFICATION OF CAVITIES

Several years ago Doctor Jaches of New York City gave me my first real lesson in the roentgen-ray diagnosis of chest conditions, and I shall quote freely from him, especially as regards classification of cavities. He describes three types of cavities, with minor modifications, which are due to the transition of one form into another.

The first type is the annular cavity, which is found especially in early tuberculosis and is the result of breaking down of the proliferative type of lesions, and in which caseation is not extreme. These early cavities are traversed by lung markings, and their favorite site is in the infraclavicular region near the axilla. The smallest cavities may be only a fraction of an inch in diameter or may attain the size of two or three inches. They usually are single and are often overlooked on

physical examination because they are not surrounded by consolidated lung and do not communicate with bronchi and are, therefore, not transmitted to the surface of the chest.

The second type of cavity lies in a densely infiltrated lung in which it is formed by the rapid breaking down of caseous tissue. These have a punched-out appearance and often show a fluid level, and are usually surrounded by a well-defined wall which is composed of both fibrous tissue and adjacent consolidated lung. Like the cavities of the first variety these are more commonly seen in the upper lobes, but may be found in any portion of the lung where rapid breaking down of tissue is occurring. The cavities are of various sizes and shapes, depending on their location and the degree to which the fibrous wall is formed about them. In acute caseous cavities there is usually an irregular excavation with no evidence of a limiting membrane. On the other hand, if the patient survives, there is the formation of a capsule, which is generally circular in outline. With this progressive type of lesions it is not uncommon for a whole lobe or a whole lung to become excavated, as we have encountered in our institution in a few instances. These types may not have trabeculations in their walls, and, if air containing, closely resemble a localized pneumothorax. Many such, no doubt, have been diagnosed pneumothorax. In cavity formation there is usually a definite roughly circular wall and a slight amount of lung marking discernible, therefore these are not distinctive of pneumothorax. Peripheral compression is common, but localized pneumothorax is not so common. Cavities may be multilocular and assume bizarre shapes. Giant cavities are seldom seen with a fluid level, but in the punched-out variety a fluid level is frequently seen. It shows how complete a drainage we have in these cases and still at autopsy we saw in one case the openings into the bronchus exceedingly small and tortuous and only discernible by hunting with a small probe. I wonder if some of these have been called the closed type. Sometimes a cavity, owing to its deficient drainage, becomes full of fluid, excluding its punched-out appearance and making interpretation difficult, especially in a lung that has little infiltration. The history and the clinical aspect of the case will help to differentiate it from lung abscess.

The third type of cavity represents the terminal stages of cavities as just described, in which conservative influences limit its extent and attempts to encapsulate it. The indurative tendency of apical disease here manifests itself. We find cavities of moderate size surrounded by dense fibrous tissue and many dense adhesions and thickened pleura. The adhesions and thickened pleura prevent compression from artificial pneumothorax, but fortunately these kinds of cavities usually do not need compression. Patients who have these types of cavities have a fair degree of health. These are the patients upon whom a diagnosis of chronic bronchitis, bronchiectasis, or emphysema may be made. Their cavities are lined with

smooth, connective tissue, their expectoration may be slight, and may contain no tubercle bacilli.

SOLITARY CAVITIES AND POSTURAL DRAINAGE

The discovery of a cavity which lies in an apparently healthy lung is rather rare. We must assume that the infiltration which had previously been present was completely absorbed and that only the cavity remains. These cavities are very prone to become larger and show fluid level. We have seen quite a number and have tried postural drainage with fairly good results. Roentgen interpretations can be of aid to the clinician in these cases. If a cavity shows a persistent fluid level the drainage may be higher up in the cavity wall. Sometimes we observe a definite break in a rather thick-walled cavity, and we assume this is the favored point of drainage. A cavity in the upper lobe is more likely to have adequate natural drainage, and a cavity in the region of the hilum is in close relation to large bronchi and is likely to drain spontaneously. On the other hand, a cavity close to the periphery of the lung is in connection with only small terminal bronchi and can rarely be emptied satisfactorily by postural drainage. A lower lobe cavity usually drains best when the patient lies with the head down on the side opposite the lesion. Position of patient depends usually on chance relation that the cavity may bear to the bronchus with which it communicates. Multiple small cavities with thin walls may resemble bronchiectatic cavities and are sometimes very hard to diagnose. If these small cavities are found in the lower lobe or lower part of the lungs and there is a history of pneumonia, especially of repeated attacks and of abundant foul-smelling sputum, it is quite suggestive of bronchiectasis, which diagnosis is made more convincing if the patient has clubbed fingers and has had several negative sputums.

In some cavities, as in the saccular type, the roentgen ray gives a characteristic picture. These are honeycombed, spongy-appearing densities, which are usually acquired in childhood, following pneumonia. The installation of lipiodol will often clear up the diagnosis.

A patient on whom an autopsy was done had far advanced pulmonary tuberculosis and a tuberculous meningitis. Roentgen ray and physical findings indicated multiple small cavities in both upper lobes. The autopsy verified the diagnosis of tuberculosis, but instead of finding small cavities in both upper lobes, our pathologist found tubular bronchial dilatations, most of which were in the primary trunks. What was actually seen in the films were cross-sections of these dilated bronchi.

A considerable hindrance in the diagnosis of cavity formation is a thickened pleura, but usually if the pleura is not too thick or too general, a circular area of decreased density can be made out and a diagnosis established. Fluoroscoping and taking roentgenograms in different positions will be a great aid in such cases. If the obliteration is

by fluid this can be aspirated and a diagnosis can then be made.

HEALING OF CAVITIES

A few years ago it was generally accepted that cavities of any size never healed. We now know differently. They heal and sometimes with great rapidity. In our institution with over six hundred patients we have found large cavities that have shrunk, changed shape and completely disappeared. The changing in shape and size, and the complete disappearance of annular shadows do not indicate that the shadow in question was not a cavity. Not long ago I attended a meeting where there was a discussion concerning a certain shadow that had disappeared, and the clinician came to the conclusion that it had not been a cavity. If it was not a cavity, what was it? Certainly not a localized pneumothorax, for it contained lung markings and had a definite circular wall. Pleural shadows of this character are so unusual that they should not be considered, and besides if it had been a pleural shadow, it would have persisted. The correct interpretation of such shadows plays an important part in the progress and treatment. There is no doubt that a few annular shadows are due to other causes, such as a wall of a lung abscess, tumors, cysts, interlobar pneumothoraces, tuberculosis of the bronchial lymph nodes, emphysematous blebs and bronchial dilatations.

CONCEALED CAVITIES

If there is a suspicion of a cavity and it is not revealed by the ordinary stereoscopic film, other positions should be used, such as the lateral, the lateral recumbent, and the right and left oblique. I have used the lateral recumbent position in demonstrating shifting fluid levels in cavities. Cavities that show an ill-defined or ragged capsule or a well-defined capsule with frequent fluid levels, have, as a rule a poor prognosis.

Knowing how essential it is to diagnose cavities early, we may be too hasty in making our diagnoses, but it seems better to err this way than the other. For this reason I usually report everything I think suggestive, and in that way we can at least be on our guard.

CONCLUSIONS

1. All sizes of cavities, irrespective of their location, are usually diagnosed promptly by the roentgen ray.

2. Cavities heal more frequently than was formerly thought to be the case.

3. Annular shadows demonstrated on films of tuberculous patients are practically always due to cavitation; therefore all annular shadows present on such films should be considered cavities until proven otherwise.

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DISCUSSION

CARL H. PARKER, M.D. (65 North Madison Avenue, Pasadena)—Doctor Pindell has done well to emphasize the importance of cavity formation in tuberculosis and the great value of the x-ray in the diagnosis of these cavities.

It is indeed fortunate that the procedure of artificial pneumothorax, together with x-ray studies, at once proves that a cavity exists and at the same time acts as the best sort of treatment of the condition. When a shadow is seen in the roentgenogram of a tuberculous patient which has the appearance of a cavity, it seems to me to be a logical procedure to introduce air into the pleural cavity, early in the progress of the process, rather than to wait for the uncertain physical signs of the thickened walls of a long-standing lesion. If this is done I believe that the healing of cavities will be much more often accomplished than it has been in the past and that the individual patients will be saved a long and trying invalidism.

As roentgenologists we should certainly be on the alert to recognize cavities at the earliest possible moment, because of their importance to the patient.

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CHARLES G. SUTHERLAND, M.D. (Mayo Clinic, Rochester, Minnesota)—As Doctor Pindell's paper suggests, there is a three-way chance of error in the diagnosis of tuberculous cavities; they may be overlooked or mistaken for other lesions, and other lesions and conditions may be mistaken for cavities. The cavity which lies in an area of consolidation or which is completely filled at the moment of examination is scarcely demonstrable. Small cavities and newly formed cavities which are often of irregular shape and without definite walls, easily escape observation. Multiple grouped cavities can be confounded with bronchiectasis as Doctor Pindell has said. Although strong arguments have been advanced to the contrary, present opinion inclines to the view that the so-called "subpleural pneumothoraces" are really cavities, as a rule. When diagnosis is attempted on a single film, it is often easy to visualize an apparent cavity by mistaking vascular markings, scar tissue, or a portion of a rib for the wall of a cavity, and the illusion is heightened if the included area is emphysematous and bright.

In the main, cavitation is a feature of advanced tuberculosis, and while cavities may occur relatively early and their discovery is important, it is still more important that the tuberculosis itself be diagnosed, whether cavities are demonstrable or not.

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H. S. HUNSBERGER, M.D. (870 Market Street, San Francisco)—Positive x-ray proof of lung cavities requires their demonstration as circular shadows in both the anterior and lateral projections. Less positive evidence is a stereoscopic image suggesting cavity in the anterior projection. An annular shadow plus a fluid level is practically conclusive evidence of cavity. Very many cavities are not susceptible of such positive demonstration. Cavities at the apices or in the upper part of the upper lobes cannot easily be shown in the lateral view; but annular shadows that might be considered pleural rings or localized pneumothoraces—and are sometimes so considered—can also be demonstrated in carefully taken lateral views in so many instances as to raise the question whether all annular

shadows should not be considered cavities until proven otherwise. It is probable that they should.

Doctor Pindell has done a service by calling attention to the frequency of silent cavities. It sometimes happens that large annular shadows are shown in both views, demonstrating large cavities to the satisfaction of the roentgenologist, when there are absolutely no discoverable clinical signs. The clinician is sometimes inclined to doubt the presence of these cavities. In such cases the roentgenologist should stand his ground, fortified by the statements of Doctor Pindell and the autopsy statistics he has quoted from the Fitzsimmons General Hospital.

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DOCTOR PINDELL (closing)—I have used the lateral view in demonstrating cavities, as suggested by Doctor Hunsberger, and found it to be of value, but, as he has stated, "For cavities at the apices and in the upper part of the upper lobes, this position is not applicable." Therefore I consider the oblique views better when in doubt, as the greater percentage of cavities are in these regions.

Doctor Sutherland's point is well taken, when he says, "That on a single film we are likely to mistake vascular markings, scar tissue or the attachments of the anterior ribs for cavities." I usually avoid this error, for I seldom diagnose tuberculous cavities except by the stereoscope.

He also mentions "that, while the diagnosis of cavities is important, it is still more important that the tuberculosis itself should be diagnosed, whether cavities are demonstrable or not." This, of course, we all know is true, but my paper deals entirely with the diagnosis of tuberculous cavities and not with the diagnosis of tuberculosis.

In my stressing the importance of the early diagnosis of tuberculous cavities Doctor Parker has brought out one of the big points that I had in mind when he mentions artificial pneumothorax and its indications. All of us who are in large sanatoriums know that this is a recognized procedure, and it should be done early.

POSTURAL DEFECTS—CORRECTABLE IN SCHOOL PHYSICAL EDUCATION CLASSES*

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DISCUSSION by Harold H. Hitchcock, M.D., Oakland; Steele F. Stewart, M.D., Los Angeles; C. L. Lowman, M.D., Los Angeles.

THE necessity for corrective classes in physical education is readily seen when one examines the statistics of findings in large series of cases where routine physical examinations have been made of great numbers of children or young men and women as in universities, large school systems, and in recruits for military service. Such statistics show a certain percentage of any large group to be abnormal in one or more aspects of body mechanics. In some series this percentage is surprisingly large.

It might be suggested that statistics include all the very slight deviations from the normal which are of no consequence except perhaps from the minor viewpoint of cosmetics. In answer to this argument, it can only be said that the danger to health and well-being is a potential one and that whatever measures are adopted to correct even the slightest defect, are justified if they bring the individual to the fullest possible physical capacity

* Summary of a talk given by the author before the physical education teachers of the Pasadena schools.